18

INFORMATION TECHNOLOGY[1]

JCALS Goal Statement: *"Provide timely, authorized access to accurate, current data anywhere in the system regardless of where it is stored, how it is formatted, or how it is accessed."*
Computer Sciences Corporation, in briefing to DSMC on 3 April 1997.

18.1 INTRODUCTION TO INFORMATION TECHNOLOGY DATA

18.1.1 Definitions

- Information Technology: "... any equipment or interconnected system or subsystem of equipment, that is used in the automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information by the executive agency ... includes computers, ancillary equipment, software, firmware and similar procedures, services (including support services), and related resources." (PL 104-106, Sec. 5002)

- Information Technology Architecture: "... an integrated framework for evolving or maintaining existing information technology and acquiring new information technology to achieve the agency's strategic goals and information resources management goals." (PL 104-106, Sec. 5125)

- Automated Information System (AIS): A combination of computer hardware and software, data, or telecommunications that performs functions such as collecting, processing, transmitting, and displaying information. Hardware and software computer resources are excluded if they are physically part of, dedicated to, or essential in real time to the mission performance of weapon systems. (DoD 5000.1, paragraph C.4.)

This Chapter gives emphasis to logistics information technology in the context of digital data, i.e., digitally developed (digitized) data that may be accessed or delivered, indexed, and maintained using automation techniques. Logistics digital information may take the form of technical data, drawings, schedules, or general reports.

[1] Much of the material in this Chapter is drawn from the DSMC published report of the Military Research Fellows, DSMC, 1995-1996, *Navigating The Digital Environment: A Program Manager's Perspective*, by P. F. Cromar, A. G. Wiley, and R. L. Tremaine.

18.1.2 Application

Program Managers (PMs) and their systems engineering staffs (including logisticians) should consider how to apply and exploit the digital information environment. In this regard, Cromar, Wiley, and Tremaine (noted in footnote 1) offered the concept of an Acquisition Program's Digital Environment (APDE) to describe a cross-functional, integrated digital information infrastructure that supports a DoD acquisition program. The APDE links the entire acquisition program team, including not only the PM office and prime contractor personnel but also subcontractors, vendors, suppliers, support agencies, and end users. An APDE can take many forms, depending largely upon the extent to which an acquisition program is able to exploit digital information technology and integrate processes efficiently and effectively. If increased productivity and substantive cost savings through process improvement and reengineering are program objectives, evidence shows that such a digital environment is a key enabler and a necessary precondition for success.

18.1.3 Digital Fog

A " fog" can easily screen the PM's view of the digital information environment. The DoD and industry have been incorporating many digital initiatives for streamlining, promoting greater competition, and improving business practices for the last decade with a confusing number of digital directives, digital standards, and digital strategies. Integrating digital information environments is relatively recent and revolutionary. Notwithstanding, there is no single organization in the acquisition community responsible for developing and maintaining a roadmap that would help PMs navigate their respective digital domains. The researchers were told by one PM, " The lack of definitive guidance and a prescribed way to do it are the biggest blocks. We are having to feel our way through, and we may be going down a dead-end path." Not surprisingly, the employment of integrated digital environments within PM offices has been uneven. The creation of one might be constrained both by the PM's vision and the program budget, even though the PM may recognize " information technology must be viewed as an investment."

Even though available guidance on how to best exploit the digital environment to support their strategy has not yet materialized, a few program offices have taken advantage of the enabling and evolving digital resources. On the other hand, more and more industry partners are designing, manufacturing, testing, and supporting defense systems within digital environments, developing new systems digitally, and creating dynamic digital enterprises. Being at the center of their system enterprise, the government PM must understand an integrated digital environment before ever hoping to properly exploit its advantages.

Since 1988, the DoD has spent between 4 and 5 billion dollars fueling the many components of an Integrated Data Environment (IDE) in an attempt to accommodate the delivery of digital product data to the weapon system sustainment communities. Despite DoD's efforts, however, an IDE's benefits to the acquisition community are not always well known, well understood, or well communicated. In some cases, promises of signifi-

cant overall cost reductions are not even believed. Most DoD training courses are targeted toward logisticians, contracting officers, engineers, and data managers. They do not focus on PMs or on integrating processes. The basic construction of a robust IDE may not be inexpensive; this compounds the problem and raises the issue of who is responsible for payment. In light of shrinking defense budgets, PMs may be left with doing everything they can to simply sustain their program and continue to satisfy the user's needs. Since 1994, some major weapon programs have had to be realigned annually because of congressionally directed funding reductions. It is easy to understand why resources necessary for a robust digital environment may be sacrificed as PMs may not easily envision a return on investment during their watch. Clearly, the PM needs to know what is important and what works today: (1) before committing any program dollars for an APDE and (2) before the DoD can expect the PM to "buy-in" to the proposed merits of an APDE.

18.2 THE DIGITAL ENVIRONMENT

18.2.1 A Short History

The current DoD effort to move acquisition and logistics into the digital age began in late 1984 with the enactment of Public Law 98-525. An outgrowth of this law was an Institute for Defense Analysis (IDA) study released in June of 1985, which recommended a strategy and master plan for Computer Aided Logistics Support (CALS) for the management of technical data. This led to the establishment of the DoD CALS Office (now Continuous Acquisition Life-Cycle Support Office). The role of CALS grew in the late 80s and early 90s. During this period, Electronic Commerce/Electronic Data Interchange (EC/EDI) emerged to enable computer-to-computer exchange of business information. It provided a standardized means to integrate business functions, enable process improvements, and establish a basis for virtual enterprises. In 1994, EC/EDI responsibilities were moved from the CALS Office to an Electronic Commerce (EC) Office, established under the Deputy Under Secretary of Defense (Acquisition Reform) (DUSD(AR)). While supporting DoD-wide efforts to enable the exchange of a variety of business processes through EDI, the primary responsibility of the EC Office is to manage the implementation of EDI-based contracting. See Figure 18-1.

Recognizing the fact that the CALS effort started in the logistics community and organizationally remains under logistics makes it exceptionally hard to overcome the stereotype that CALS is a purely logistics program. Interviews by researchers Cromar, Wiley, and Tremaine (noted in footnote 1) showed that several senior DoD officials believe that the CALS current efforts concentrate primarily on logistics and sustainment activities. Similarly, EC Office efforts have been largely directed at the contracting community and small procurements, despite significant support to other EDI-related business processes. While both the CALS and EC/EDI offices are working to advance the acquisition community, the perception in the field is that they are separate, functionally based initiatives that do not specifically focus on or address the information and business needs of the PM.

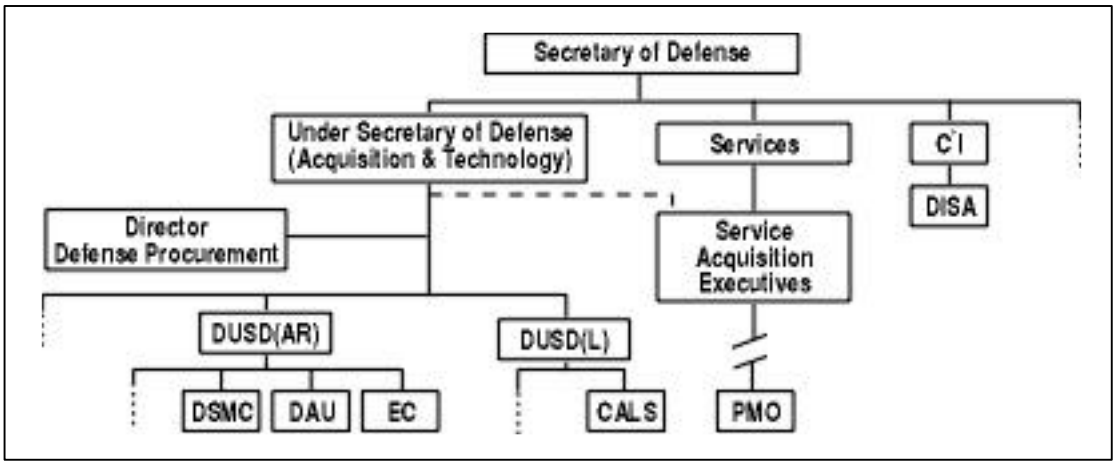

Figure 18-1: Major DoD Organizations Involved in the Digital Environment

18.2.2 Major Players

While DoD would like to present a "single face" to industry, the Services, and PM offices, there are a variety of organizations involved in different aspects of the digital environment. A digital environment that supports the acquisition community must interconnect with the Defense Information Infrastructure (DII), which, in turn, is an integral part of the National Information Infrastructure (NII). Agencies, apart from DoD, such as NASA, Department of Commerce, Department of Treasury, and the Department of Energy, are also affected. Business processes and standards clearly have global applications. This section identifies some of the major players involved in aspects of the digital environment and summarizes their functions, particularly as they impact the acquisition community. While many of these organizations will not directly affect PM offices, it is useful to understand their areas of focus and the roles they play.

18.2.2.1 DoD CALS Office. This office is under the Deputy Under Secretary of Defense (Logistics) (DUSD(L)) and is responsible for leading the DoD CALS effort. The CALS Office responsibilities include:

- Coordinating within OSD to define the IDE for business and technical information used for system acquisition and life-cycle support. (The IDE will be congruous with industry practices and the overarching DoD information infrastructure being developed by the Defense Information Systems Agency (DISA));

- coordinating the IDE framework within the DoD and ensuring integration of those requirements into DoD programs and processes; and

- participating with other government departments in an industry outreach program. (Through that program, the CALS Office promotes a commonly shared information framework, compatible information infrastructures, and similarity of acquisition practices.)

18.2.2.2 DoD Electronic Commerce (EC) Office. This office is responsible for facilitating the implementation of EC/EDI across all functional lines within DoD. It also developed the *Introduction to Department of Defense Electronic Commerce: A Handbook for Business*, Version 2, June 1996, which is a useful source of EC/EDI information. To date, the primary focus of the DoD EC Office has been to manage the implementation of EDI-based contracting systems within 244 DoD installations.

18.2.2.3 Director, Defense Procurement. As a Principle Deputy to the Under Secretary of Defense for Acquisition and Technology (USD(A&T)), the Office of the Director, Defense Procurement, develops, interprets, and publishes procurement policy for DoD. The Office of the Director also establishes requirements and guidelines that regulate the exploitation of digital environments and plays an integral role in DoD business process improvement initiatives. Defense Procurement sets policy for government rights to technical data and develops standardized procurement data definitions and a standard procurement process.

18.2.2.4 Defense Information Systems Agency (DISA). Under the auspices of the Assistant Secretary of Defense (Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance), DISA is responsible for promulgation of standards and primary support of the DII. With respect to the development of a digital environment, DISA's role is to develop the computer systems architecture in close coordination with the Defense Information Systems Agency (DISA); the goal is to have it fully integrated with system migration planning and to be ultimately realized via the DII. The objective of the architecture is to completely describe the communications and computer system infrastructure necessary to support the IDE. Another objective is to develop the plan to efficiently migrate both the CALS flagship systems and the remainder of the DoD computer systems infrastructure that supports the weapon system life cycle to an IDE state. The computer systems architecture will include a systems specification that identifies the interfaces and performance standards necessary to meet the functional requirements of the weapon system support community.

The CALS Digital Standards Office at DISA is charged with overseeing CALS standards activities. DISA is also responsible for providing information pertaining to the testing and certification of Value Added Networks (VAN), which support the DoD EDI effort.

18.2.2.5 Other Organizations. Other organizations involved in different aspects of the digital environment include the: (Functions of these organizations are outlined in Section 18.7, reference 1, of this Chapter.)

- Defense Acquisition University/Defense Systems Management College,

- National Institute of Standards and Technology,
- Industry Steering Group, and
- Electronic Commerce Resource Center.

18.2.3 Definitions and Terms

This section will provide an overview of some of the major terms and initiatives that impact PM organizations entering the digital environment.

18.2.3.1 Continuous Acquisition and Life-Cycle Support (CALS). CALS is a DoD and industry strategy to accelerate the pace at which high quality information flows within and between DoD and its business partners. The CALS also provides an opportunity to reduce information management overhead costs. CALS is a core strategy to share integrated digital product data through a set of standards to achieve business efficiencies in business and operational mission areas.

The DoD CALS Office is committed to incorporating CALS into functional process improvements. As DoD attempts to apply the best technologies, processes, and standards for the development, management, exchange, and use of business and technical information among and within governmental and industrial enterprises, an IDE will be generated. DoD has developed a strategic plan to pursue its IDE vision.

18.2.3.2 Integrated Data Environment (IDE). The IDE is the business environment created by the application of existing national and international standards, practices, and technologies to automate the management and exchange of information. The vision of this DoD-wide IDE is a boundaryless environment where all data are accessible to appropriately cleared personnel in all defense enterprises. The IDE enables Integrated Product and Process Development (IPPD) while increasing the agility and decreasing the cycle times of the defense enterprise.

The goal of the IDE may be best summarized as an integrated digital environment linking all stakeholders in the life cycle of a weapons system and allowing cross functional sharing of data that is created once and used throughout the entire life cycle of the system.

18.2.3.3 CALS/IDE Initiatives. As part of the CALS strategy, the DoD is pursuing three infrastructure modernization programs with the goal of enabling the IDE. They are the Joint Computer-aided Acquisition and Logistics Support (JCALS), Joint Engineering Data Management Information Control System (JEDMICS) and Configuration Management Information System (CMIS). These three systems are being developed independently to work together in support of the DoD-wide IDE. The Army's Combat Mobility Systems (CMS) was the first program office to integrate these systems beginning in mid-1995.

18.2.3.4 Electronic Commerce (EC). The term EC is widely used by both the U.S. Government and industry. In industry the term EC is frequently used as the umbrella term to describe any digital exchange of information or data. Similarly, within DoD, EC is defined as the paperless exchange of business information using EDI, Electronic Mail (E-Mail), computer bulletin boards, facsimile, Electronic Funds Transfer (EFT), and other similar technologies.

18.2.3.5 Electronic Data Interchange (EDI). EDI is the computer-to-computer exchange of business information using a public standard. EDI is a central part of EC because it enables organizations to exchange business information electronically and much faster, cheaper, and more accurately than is possible using a paper-based system.

Who uses EDI? Currently about 50,000 U.S. private sector companies such as Federal Express, Eastman Kodak, American Airlines, Nike, Staples, Nations-Bank, JC Penney, and Prudential Insurance, use EDI. EDI is widely used in manufacturing, shipping, warehousing, utilities, pharmaceuticals, construction, petroleum, metals, food processing, banking, insurance, retailing, government, health care, and textiles, among other industries. According to a recent study, the number of companies using EDI is projected to quadruple within the next six years. The government did not invent EC/EDI; it is merely taking advantage of an established technology that has been widely used in the private sector for the last few decades. American National Standards Institute (ANSI) X12 U.S. commercial standards were developed to support EDI transactions for a wide variety of industry information applications. In the future ANSI X12 is expected to gradually align with an international set of EDI standards that are sponsored by the United Nations and known as Electronic Data Interchange for Administration, Commerce, and Transportation (EDIFACT).

18.2.3.6 Federal Acquisition Computer Network (FACNET). In 1994, Public Law 103-355, Federal Acquisition Streamlining Act (FASA), established the FACNET, requiring the government to evolve its acquisition process from one driven by paperwork to an expedited process based on EDI. The electronic system is intended to provide a " single face" to industry. FASA establishes parameters for FACNET users, both government and private. These functions are to be implemented by agencies within five years of enactment of the Act. The government-wide FACNET will be designed to:

- inform the public about Federal contracting opportunities,
- outline the details of government solicitations,
- permit electronic submission of bids and proposals,
- facilitate responses to questions about solicitations,
- enhance the quality of data available about the acquisition process, and
- be accessible to anyone with access to a personal computer and a modem.

Very simply, FASA raises the small purchase threshold to $100,000 and designates this as the simplified acquisition threshold. Procurement activities can use these new procedures when their activity is FACNET-certified. Although FACNET is currently in use by over 200 DoD organizations and installations, there are other potential options. With the advent of the World Wide Web (WWW) some government activities, most notably NASA and DLA, have chosen to employ what they consider to be more open solutions than those presented by the FACNET.

18.2.3.7 Contractor Integrated Technical Information Service (CITIS). CITIS is a contractor-developed and maintained service to provide electronic access and/or delivery of government-procured, contractually required information (i.e., Contract Data Requirements List (CDRL)). CITIS generally employs electronic networks for access and delivery of information and may include vendor and supplier data. It should be noted that CITIS is not the data itself or the database where it resides; CITIS is simply the service or mechanism that provides authorized users access to the data. CITIS can be the backbone of a Program Management Office (PMO) integrated data environment, providing significant benefits to the PMO. It provides a single entry point for authorized government access to contractor-generated CDRL data and supports the philosophy of creating data once and using it many times. CITIS establishes a set of core information functions to facilitate the concept of "shared data," and standardizes functional characteristics of the data to facilitate usage by a wide variety of different users.

18.2.3.8 Workflow Manager. A workflow manager is a software application designed to increase productivity. Using customized rules or knowledge-based processing, workflow managers enhance operations by automatically managing:

- single point of administration and maintenance;
- assignment of tasks (personal and group);
- automatic initiation of actions;
- coordination, timing, and sequencing of events;
- notification, suspenses, and e-mail-based reminders;
- work in progress reports (project and process status);
- continuous quality control (data integrity); and
- data rights and access.

A workflow manager can be a key functional component of an integrated digital environment, helping organizations achieve greater efficiency through near real time collaboration despite geographic and functional separation. By design, workflow managers go

beyond e-mail by permitting greater flexibility through parallel processing, quicker access to the correct data by the right people at the appropriate time, and by providing a coordinated and integrated decision-making environment.

18.2.4 Acquisition Program's Digital Environment (APDE)

The researchers, Cromar, Wiley, and Tremaine (noted in footnote 1) developed the concept of an APDE. Defined as a cross-functional integrated digital environment linking the entire acquisition program team, the APDE is a realizable, program specific subset of the DoD-wide IDE vision. APDE focuses on an individual acquisition program with its development controlled by the PM. APDE supports program-specific requirements and enables process improvements, increases in efficiency, and reengineering efforts, which are achievable by both the PM office and government-industry acquisition partners.

An APDE can range from being very simple to very complex. At the low end, key people may share e-mail and limited information sets within the PMO and/or with the prime contractor, perhaps incorporating commercial software to facilitate data access. At the high end, an extensive digital infrastructure enables every active participant to have direct access to all pertinent data relating to one's function or process, regardless of the physical location of the database. These active participants include not only the PM office and prime contractor personnel but also sub-contractors, vendors, suppliers, support agencies, and end users. The elements may include topics noted in section 18.2.3 of this chapter. What is right for a particular PMO is a point somewhere along a continuum of increasing APDE complexity. As with the IDE, the use of standards to support data exchange and interoperability are essential to an APDE.

18.2.5 Digital Environment Summary

Moving into the information age and exploiting the potential of integrated digital environments is key to the future success of the acquisition community. As this movement necessitates crossing functional, organizational, and process boundaries, there are far reaching implications that impact DoD, the U.S. Government, industry, and even the international community. The defense acquisition community must at least be aware of these factors and attempt to take advantage of opportunities that they present. There are many organizations that play an active role in information technology and the digital environment, along with numerous ongoing and overlapping initiatives. In some cases, ongoing efforts are beyond the control of the PM. However, there is still much that can be done that will enable the PMO, and industry partners to capitalize on such items as the APDE initiative.

18.3 WHY USE A DIGITAL PROCESS?

There are two distinct, and somewhat overlapping, reasons for the PM to transition from a paper-intensive environment to a digital environment. The first is that DoD policy requires movement away from paper-based processes as quickly as possible. DoD Regulation 5000.2-R requires all new contracts (starting in FY97) to require online access to, or delivery of, their programmatic and technical data in digital form. A more compelling reason is that it simply makes good business sense. The importance of information technology to the logistics manager is addressed in section 18.6 of this chapter.

18.3.1 IPPDs and Reengineering

A key element in DoD's attempt to reengineer the acquisition process is the use of Integrated Product Teams (IPTs) and IPPD concepts. This is an area where defense acquisition programs can learn from industry. Many of the recent "success stories" in the media concerning improvement in competitiveness of American firms can be traced to the aggressive use of digital environments and the creation of an IPPD environment. One example is Boeing's decision to use Computer-Aided Three-dimensional Interactive Applications — CATIA software — for the development of the 777 aircraft. Boeing's management made the decision to change the culture of the company (IPPD) and invest $100 million in a computer-aided development capability. The bigger "investment" was in the total corporate commitment to this approach — there was no fallback approach in place.

As a result, there is no physical mock-up for an aircraft with 85,000 components and over four million parts. The goal is to achieve the same number of manufacturing hours as the 767 – for an aircraft with 57 percent greater empty weight – by reducing the number of design changes to at least one-half of that experienced on the 767. To date, Boeing is reporting a 93 percent reduction in the number of design changes. (To bring some balance to the above positive examples, the Journal of the DoD Reliability Analysis Center, Second Quarter 1997, reports a higher than expected rate of malfunctions on the 777 by one airline user; plus there are problems caused by electronic complexity and electromagnetic compatibility.)

A second example illustrates the point that computer-assisted integrated product development is not just for large corporations. Kohler's Engine Division, a producer of small 5 to 25 horsepower 4-cycle lawn mower engines, is a small player in a big field. Their business strategy is fairly straightforward — sell engines by offering superior performance and high reliability at a lower cost. Kohler has been using state-of-the-art CAD/CAM [computer-aided design/computer-aided manufacturing] tools to introduce new designs that are radically different from earlier versions, which is quite a departure from the evolutionary change approach traditionally practiced by this industry. At Kohler, manufacturing cycle times have been cut significantly. Physical prototypes are no longer necessary. Kohler offers a 2-year warranty — the longest in the industry.

In these examples, both companies implemented the commercial equivalent of an APDE to exploit an IPPD environment. This was made possible through the use of an APDE. The traditional use of prototypes to ensure form, fit, and producibility was obviated by the APDE's ability to enable a truly concurrent engineering and development process. This radical improvement in program performance is a clear example of why PMs should embrace the APDE.

18.3.2 The APDE and DoD

In DoD acquisition programs, well over half of the total life-cycle costs of weapon systems are fixed early in the program's development. The PM should focus on reducing total life-cycle costs early in the development process. The APDE directly enables this to occur by allowing the PM to create an IPPD environment to ensure that all stakeholders are involved and data and process requirements are identified up front. The PM can then plan for reducing long-term costs.

18.4 THE DOD DIGITAL WORLD IN 1997

Despite many positive efforts within DoD, the research report, *Navigating the Digital Environment: A Program Manager's Perspective,* concluded that:

> " There is no universal APDE standard or *truth* among the organizations examined. There are just too many implementation options available. As one expert in industry so fittingly stated, 'there is no silver bullet single solution. ... it requires a major investment which is difficult to find when the attention is on reducing overhead costs in a downsizing environment.' Because an APDE-like concept is relatively new and evolving, an understanding of the context of why and how organizations create them is essential. Our research further investigated barriers encountered in adopting an APDE. Not surprisingly, the researchers noticed a wide-range of reasons, both supporting and limiting APDE development."

18.4.1 Obstacles

Even though organizations are conducting business using digital technology, very few possess a coherent game plan that outlines the requirements and objectives for integrating digital environments. The knowledge level of particular software packages, like e-mail, word processing, and spreadsheets, and their respective benefits to individuals is high. Conversely, the level of understanding regarding how to integrate digital environments across functional areas and processes is low.

Cromar, Wiley, and Tremaine concluded that there are many misconceptions regarding the need for and general employment of an integrated digital environment. Only a limited number of the sites they visited seemed to appreciate what integrated digital environments offer, what constitutes an IDE, and what initiatives are available to help their organization develop an IDE best suited to meet their needs. Most organizations that did

recognize the need for an IDE were not aware of any resources available to help them construct one. Organizations feel they are on their own and tend to reinvent the wheel.

Other obstacles include the slow migration of certain enabling digital technologies within DoD, difficulty in selling the usefulness of information technology, decision makers believing in information technology cost savings, and related cultural barriers. Security concerns also exist in the area of proprietary data and classified data.

18.4.2 Standards and a Common Data Environment

The DoD is actively pursuing the use of commercial standards such as ANSI X12, standard generalized markup language (SGML), initial graphics exchange specification (IGES), and commercial products instead of government off-the-shelf (GOTS) packages. Quite a few organizations interviewed by the study group have installed commercial products as a solution for the management, exchange, manipulation, and storage of electronic data. This solution was used because some DoD-sponsored standard systems, like JCALS, JEDMICS, and CMIS, are still not sufficiently mature (in the opinion of some) and are considered to be less capable than commercial alternatives. According to a senior DoD official, some organizations also want to avoid the Ada (Department of Defense high order software language) paradox, according to a senior DoD official, where what had been originally designed to be a solution to interoperability has become a burden.

An example of the application of standards and a common digital environment is the Joint Strike Fighter (JSF) Program Office, formerly Joint Advanced Strike Technology (JAST) Program Office. With few exceptions, this office operates in a paperless environment. Early on, the JSF Program Office strangely pushed electronic procurement, even though there were few standards or experienced personnel to guide such efforts. They train, make decisions, plan upcoming phases, receive and evaluate deliverables, award contracts, conduct frequent management reviews, and review technical information – all electronically in a common data environment. In addition, they have online access to contractors' management information systems (MIS). The JSF Program also uses an Internet web site to distribute solicitations, broad agency announcements, and Request for Proposals (RFPs); respond to questions from potential offerors; inform prospective bidders of the latest information that might affect contract proposals; and answer questions related to their solicitations. The JSF Program has declared that business with them will take place digitally, and it subscribes to a common information systems environment.

18.4.3 Near-term Action

The CITIS is addressed in section 18.2.3.7 of this chapter. The careful design of a CITIS is probably the most important decision a PM can make in satisfying program data needs through an APDE. This is especially true in light of the requirements of DoD 5000.2-R, which states: " Support concepts of new and modified systems shall maximize the use of contractor provided, long-term, total life-cycle logistics support." In most cases, a contractor's CITIS is robust enough to provide easy access to the data. Cromar, Wiley,

and Tremaine revealed many variations in how DoD organizations establish and maintain connectivity among information environments. MIL-STD-974 defines the functional requirements for CITIS and permits a great deal of flexibility as evidenced by its four implementation strategies:

- Database repository resides with the prime contractor as a single physical integrated database.
- Database repository resides with the prime contractor as distributed multiple databases with a navigator (gateway processor).
- Database repository resides with the prime contractor; existing information systems are interfaced to extract CITIS data in a central repository.
- Database repository resides with the prime contractor and suppliers (many), with a navigator to pass requests/access to supplier databases.

Some PMOs tap directly into a prime contractor's CITIS, located either inside or outside the contractor's boundary, and extract the appropriate data on demand. Other PMOs avoid a CITIS and have the contractor deliver digital data to a remote server that is operated and maintained by the sponsor.

However, producing an efficient CITIS and justifying its usefulness is not an easy undertaking. A CITIS should have certain characteristics that everyone on the team understands, and it should be simple to use. CITISs must be reliable and straightforward; otherwise, the exchange of digital information, whether technical data, drawings, schedules, or general reports, can become a cumbersome and inefficient operation.

18.4.4 Digital World Summary

While there are many ongoing innovative digital initiatives throughout DoD, the acquisition community is not fully prepared to capitalize on the benefits or potential of integrated digital environments. Implementation of digital environments widely differs between the Services and PMOs. Lessons learned by industry in the exploitation of the information age and information technology are not well understood or appreciated within PMOs. The driving forces for organizations to adopt APDEs are reducing overall costs and increasing performance, not policy, mandates, or DoD direction.

18.5 PROGRAM MANAGER'S DIGITAL CONCERNS

The PM must have the vision or ability to understand the potential for a cross-functional, integrated digital environment. Interviews have shown that extensive technical knowledge or detailed, functional acquisition experience is clearly not a prerequisite for the success of an APDE. In fact, too much technical background or experience may result in decisions being clouded by preconceived ideas. The PM must understand that information itself is an asset that needs to be managed carefully over the entire life cycle of the

program. Information is more than simply a gathering of data used to describe assets and actions. Information has value, it has multiple uses and purposes, and it supports everything relating to the acquisition program. Properly managed, information can save time, increase efficiency, improve system quality and performance, and reduce cost. The APDE enables this effective management of information and information processes.

18.5.1 Gain Access to the Right Tools

In most PMOs, there exists a general lack of experience and knowledge with respect to the potential, requirements, capabilities, and limitations of an integrated digital environment. DoD acquisition personnel, and many industry managers for that matter, do not feel adequately prepared to develop an APDE infrastructure. The general sentiment from several study interviewees was that, " we don't even know enough to ask the right questions, let alone come up with the answers." It is important for the PMO to be able to access information and personnel that can help them negotiate an APDE development effort. The PM needs individuals with an understanding of APDE-related areas such as available technology; network support and network security; communications requirements and capabilities; data rights and access restrictions; CITIS; computer-aided design/computer-aided manufacturing (CAD/CAM); CALS; EC/EDI; national and international standards; and lessons learned from other PMO initiatives. In many cases the information and assets are not found within the PMO. Training programs, other DoD agencies, and PMOs, consultants, outside research, and contractors should be used extensively to support the APDE development process.

18.5.2 Policy Matters

18.5.2.1 Programmatic Data. DoD 5000.2-R states that, beginning in FY97, all new contracts shall require online access to, or delivery of, their programmatic and technical data in digital form, unless analysis shows that life-cycle time or life-cycle costs would be increased by doing so. Preference shall be given to online access to contractor-developed data through contractor information services rather than data delivery. No ongoing contract, including negotiated or priced options, shall be renegotiated solely to require the use of digital data, unless analysis shows that life-cycle costs would be reduced. This final item is being considered for revision.

18.5.2.2 MAISs. Further, DoD 5000.2-R describes operating procedures that are mandatory only for Major Defense Acquisition Programs (MDAPs), Major Automated Information System (MAIS) acquisition programs, and for other acquisition programs as specifically stated therein. DoDD 8000.1 provides complementary guidance for MAIS functional areas and describes management principles that are mandatory for all information management activities, including those related to acquisition of information systems,
resources, services, and infrastructures.

An AIS acquisition program is a program that (1) is designated by the Assistant Secretary of Defense (Command, Control, Communications, Computers, Intelligence, Surveillance

and Reconnaissance) as a MAIS or (2) is estimated to require program costs in any single year in excess of $30 million in fiscal year FY96 constant dollars, total program costs in excess of $120 million in FY96 constant dollars, or total life-cycle costs in excess of $360 million in FY96 constant dollars. MAIS acquisition programs do not include highly sensitive classified programs (as determined by the Secretary of Defense). For the purpose of determining whether an AIS is a MAIS, the following shall be aggregated and considered a single AIS:

(1) the separate AISs that constitute a multi-element program;
(2) the separate AISs that make up an evolutionary or incrementally developed program; or
(3) the separate AISs that make up a multi-component AIS program.

18.5.2.3 Technology Life Cycle. Numerous DoD senior leaders have made official reference to information technology (IT) having a life cycle of 15 to 18 months or less. The literature (government and commercial) is full of articles on new engineering developments. Subjects include a new computer from Sandia National Laboratories with broad military and commercial applications. It operates at nearly 2 trillion floating operations per second to nano-technology or molecular manufacturing allowing most products to be made lighter, stronger, smarter, cheaper and more precisely by rearranging atoms and molecules. However, as noted by Dr. D. L. Losman and Dr. K. B. Moss of the Industrial College of the Armed Forces in the May 1996, *Defense & Security Electronics*:

> " ... demands of the commercial market have forced producers to change systems often to remain competitive. It is hard to imagine that the U.S. defense sector, given Congressional and presidential budgetary and oversight demands, would be able to accommodate the frequency of change that is the rule in the free-market commercial sector. Even if overall costs of electronics systems drop and thus allow more frequent changes to be financially possible (especially due to declines in the prices of hardware), Congressional budget review encourages adoption of defense systems that have longevity. Importantly, if the commercial world continually abandons older products as it moves toward newer designs and concepts, how will the military be able to provide logistical support and maintenance when the commercial products originally utilized are no longer being produced?"

For the DoD, this becomes a problem as commercial/non-developmental (C/NDI) purchases become the rule for IT; but, for both DoD and commercial markets, two other problems arise. First, when do you execute a purchase of a new or replacement IT knowing significant hardware/software improvements are likely to occur in the near term, i.e., how do you calculate your return on investment? For DoD, the relative slowness of the procurement process can mean that technology in the newly acquired product may be overtaken before the purchase is executed. Second, in a logistics context, support plans for a new system may be delayed to the detriment of the new system because of delayed IT decisions. These decisions are delayed because of the desire to use the latest IT in the system or in support of the system.

Thus, an insidious IT system/support decision loop can develop. Conversely, using currently available IT almost guarantees near immediate obsolescence. Discussion of these issues are conspicuously absent in the literature.

18.5.3 The PM Must Be Involved

The DoD strategy for an integrated data environment (IDE) is being developed by the DoD CALS office. Although CALS officially encompasses the entire life cycle of a program, the effort is run by the logistics community and has historically had a logistics focus. As a result, there is a tendency by materiel acquisition and program management to relegate IDE and CALS issues to their senior logistics personnel. This is a mistake. The PM must understand that the APDE, an acquisition program's functional equivalent to the IDE, potentially interconnects all program processes to become an indispensable tool for the PM.

18.6 LOGISTICS BENEFITS OF INFORMATION TECHNOLOGY

18.6.1 Joint Logistics

Information technology offers significant capabilities to Commanders-in-Chiefs (CINCs) as outlined in the Joint Staff's second draft of *Focused Logistics*, 30 April 1997. This draft states that "information fusion" is a primary tenant of *Focused Logistics* and is defined as "... the timely and accurate access and integration of logistics data across units and combat support agencies throughout the world providing reliable asset visibility and access to logistics resources in support of the warfighter." Accordingly, Global Combat Support Systems (GCSS) is a strategy to provide universal access to information and interoperability of that information across combat support and ultimately between combat support and command and control. A host of logistics information technology systems enablers are critical to GCSS. These initiatives are:

- automatic identification technology — ensures capturing source data from existing and future automated information systems such as bar codes, optical memory cards, radio frequency tags and movement tracking;

- joint total asset visibility — provides users with information on the location, movement, status, and identity of units, personnel and supplies;

- intransit visibility — tracks the identity, status, and location of DoD unit and non-unit cargo, passengers, and medical patients from origin to any destination; and

- joint decision support tools — aggregates, categorizes, and depicts information on force composition, environment, intensity and expected duration of operations.

18.6.2 Service Logistics

18.6.2.1 General Benefits. A primary objective of DoD information technology activity is to dramatically reduce product cycle times, to reduce DoD acquisition and support costs, and to improve readiness through reengineering acquisition and logistics processes. To attain these objects, the CALS' initiative provides the reengineering methodology, integrated information systems, and information standards that are necessary to re-invent acquisition and logistics processes across the Department. Furthermore, CALS' reliance on global standards versus defense-unique requirements directly facilitates commercial/military integration and defense conversion through streamlined processes that reflect world-class operations. As such, the CALS initiative directly supports ongoing DoD Acquisition Reform and logistics modernization efforts to reduce cycle time and life-cycle costs. Specific examples include:

- improving weapon system schedule and cost performance through reengineering and implementation of IDE;
- reducing the regulatory cost premium through policy reformation; and
- enhancing readiness through infrastructure modernization.

18.6.2.2 Specific Benefits. At this writing, the PM of Combat Mobility Systems (CMS) is a fully chartered element of the Program Executive Office, Armored Systems Modernization, responsible for the development and fielding of three weapon systems:

- M1 Breacher (Grizzly)
- Heavy Assault Bridge (Wolverine)
- Improved Recovery Vehicle (Hercules)

The first two systems are derivatives of the M1 Abrams and support engineer mission on the battlefield; the third system is a major improvement to the M88 Recovery Vehicle and supports ordnance missions. United Defense, Limited Partnership (UDLP), York, PA, serves as the prime contractor for Grizzly and Hercules, while General Dynamics Land Systems (GDLS), Sterling Heights, MI, is the prime contractor for the Wolverine.

The PM, CMS information technology concepts, planning, implementation, and approximately 25 of the program's logistics-oriented benefits from this initiative are documented in a five-page narrative on the "Web." The reader is urged to review this material at:

http://www.acq.osd.mil/cals/implcals.html

Broader examples of the logistics benefits of Service application of information technology are:

- Multi-user ECP Review System (MEARS). MICOM is automating the Engineering Change Proposal (ECP) review process with the development of MEARS. MEARS provides a tool to electronically review, comment, and vote on ECPs submitted by contractors. In the first year using MEARS, the Patriot Missile Project Office saved $250 thousand in paper alone.

- Automated Logistics Publishing System (ALPS). ALPS, a computer-generated publishing tool, is providing significant savings in the time and resources needed to support logistics publications. In addition to improved document quality, production cycle time has gone from 6 months to a few days; and the production cost per page has been reduced by 72 percent, saving more than $5.2 million over an 18-month period.

- Navy Interactive Electronic Technical Manuals (IETMs). The Navy has experienced financial savings on several systems employing IETMs relative to traditional documentation methods. In an effort to further reduce the cost of IETMs themselves, the Navy conducted a project to advance the technology necessary to allow for the automated conversion of legacy technical manuals (text, tables and graphics) to the IETM revisable database format (structured in accordance with MIL-D-87269). The conversion was to be accomplished with little or no human intervention. That goal was achieved in December 1996. As a result of the development of this automated conversion system, the cost of converting legacy technical manuals can be reduced from the current $130+ per page to a range of $40 per page or less. By transferring the technology to the commercial sector for development of commercial items, the Navy and DoD are relieved of the financial burden of maintaining, enhancing, and supporting a software system over a long period of time.

- Advanced Technical Information Support (ATIS). ATIS integrates digital engineering drawings, technical manuals, maintenance, and operational data through shipboard processing systems. Elimination of aperture cards reduced reproduction costs per ship from $54 thousand to $10.5 thousand per year and reduced the eight of shipboard storage media by close to two tons. Also, search and retrieval resources dropped from four experts to one novice per request; and the time needed to conduct a search has decreased from 30 hours to 10 minutes.

- ATIS for Naval Air Weapons System (ATIS/AIR). ATIS/AIR provides weapon system digital technical data at central technical publications libraries (CTPLs), staff offices, and maintenance workstations. It improves supply and maintenance process times; reduces the size, weight, and volume of shipboard CTPLs an average of 90 percent; and reduces librarian workloads by 30 percent for posting and distribution of technical data revisions.

18.7 REFERENCES

1. *Navigating The Digital Environment: A Program Manager's Perspective*, by P. F. Cromar, A. G. Wiley, and R. L. Tremaine, DSMC, December 1996.

2. *Focused Logistics, A Joint Logistic Roadmap*, 2nd Draft, (Information Fusion Chapter), The Joint Staff, 30 April 1997.

3. Public Law 104-106, Division E-Information Technology Management Reform.

4. *Introduction to Department of Defense Electronic Commerce: A Handbook for Business*, Version 2, DoD Electronic Commerce Office, June 1996.

5. Websites:

    - http://www.acq.osd.mil/cals/implem.html
    - http://wpafb1.wpafb.af.mil/train.html
    - http://immc.redstone.army.mil/CALS_Exchange/html/news.htm
    - http://catt.bus.okstate.edu/catt2/
    - http://navycals.dt.navy.mil/
    - http://www.navair.navy.mil/air30/air361/hp361.htm
    - http://wpaftb1.wpafb.af.mil/59b/home.html